THE STIRLING WATER TUBE BOILER

THE STIRLING CO.
Chicago.
ILL. U.S.A.

THE STIRLING COMPANY,
HERBERT F. L. ALLEN,
DISTRICT SALES MANAGER,
COLORADO BUILDING,
WASHINGTON, D. C.

THE STIRLING WATER TUBE BOILER

Manufactured by

THE STIRLING COMPANY

GENERAL OFFICES

Pullman Building, :: Chicago, Illinois

WORKS

Barberton, :: Ohio

SALES OFFICES

New York City	Engineering Building
Boston, Mass.	Delta Building
Philadelphia, Pa.	Betz Building
Pittsburg, Pa.	Germania Bank Building
Cincinnati, Ohio	Ingalls Building
San Francisco, Cal.	32 First Street
Toledo, Ohio	720 Monroe Street
New Orleans, La.	Hennen Building
Atlanta, Ga.	Empire Building

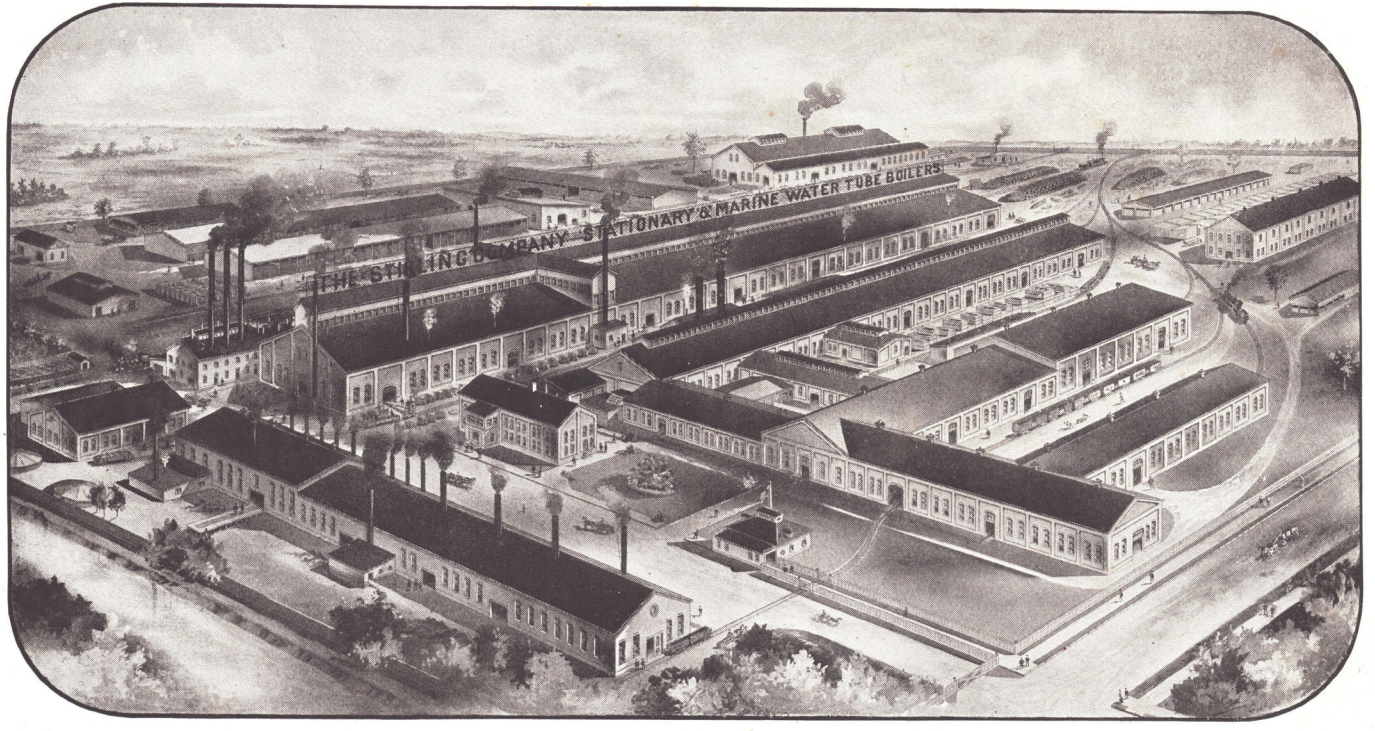
BRITISH BRANCH
E. G. CONSTANTINE, Manager
53 Deansgate Arcade, Manchester 53 Victoria St., S. W. London

JOHANNESBURG, S. A.
HERBERT AINSWORTH
35 Exploration Bldg.

YOKOHOMA, JAPAN
A. S. HAY
43 B-Yamashita-Cho

HONOLULU, H. I.
VON HAMM YOUNG CO.
Queen Street

BUENOS AYRES ARGENTINE REPUBLIC
LA CIA. DE FABRICANTES EXTRANGEROS LTDA.



WORKS OF THE STIRLING COMPANY, BARBERTON, OHIO.

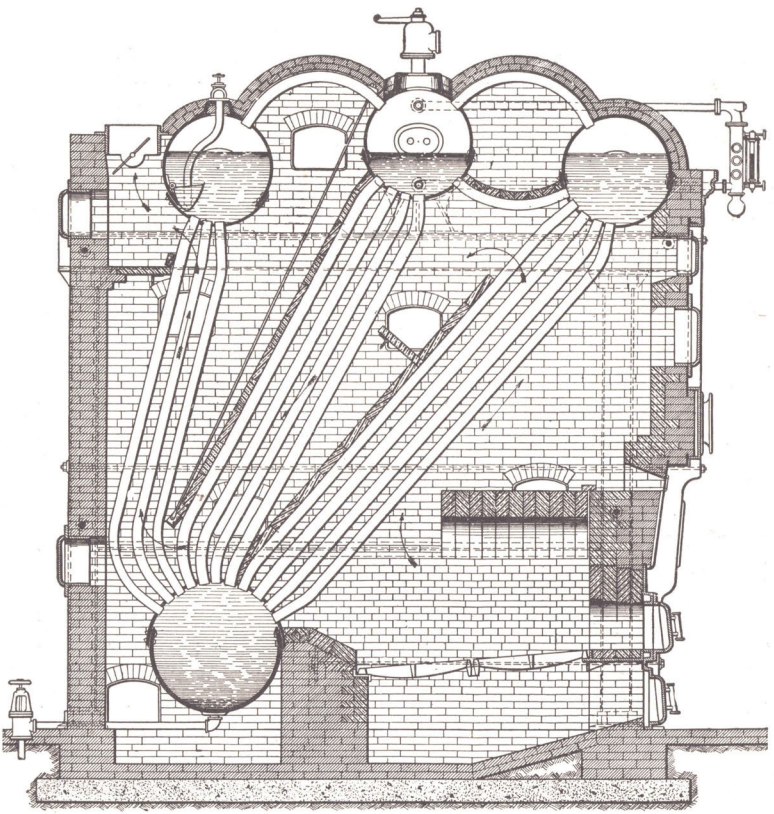
INTRODUCTORY.

THE STIRLING COMPANY is engaged in the manufacture and sale of Water Tube Boilers for all purposes for land and marine use. The company was organized in August, 1890, for the manufacture and sale of the Stirling Boiler, which, prior to that time, had been sold by the International Boiler Co., Ltd. Extensive works were erected at Barberton, Ohio, which have been largely extended from time to time as the constantly increasing sales of Stirling Boilers have demanded. In the neighborhood of 1,500,000 horse-power Stirling Boilers are in operation in the United States, Canada, Mexico, South America, Cuba, Hawaiian Islands, Japan and South Africa.

The design of the boiler is so flexible that it may be adapted to any condition that may arise; in burning anthracite culm, low as well as high grade bituminous coal, blast furnace and natural gases, sawdust and refuse from woodworking establishments, bagasse or refuse from sugar mills, it has proved alike efficient and satisfactory.

In the Marine Department the company's operations are extensive. Water tube boilers of the Niclausse type have been installed in the Russian cruiser Variag, the Russian battleship Retvizan, the United States battleship Maine, and the United States monitor Nevada, while work is actively progressing on boilers for the United States cruisers Colorado and Pennsylvania, United States battleships Virginia and Georgia, for the Great Northern Steamship Company's Minnesota and Dakota, of 11,500 horse-power each, and for the Imperial Ottoman cruiser Medjidia.

A brief description of the Stirling Boiler is submitted in the following pages, together with a partial list of users, letters of indorsement, etc.



SECTIONAL VIEW OF STIRLING BOILER—SIDE ELEVATION.

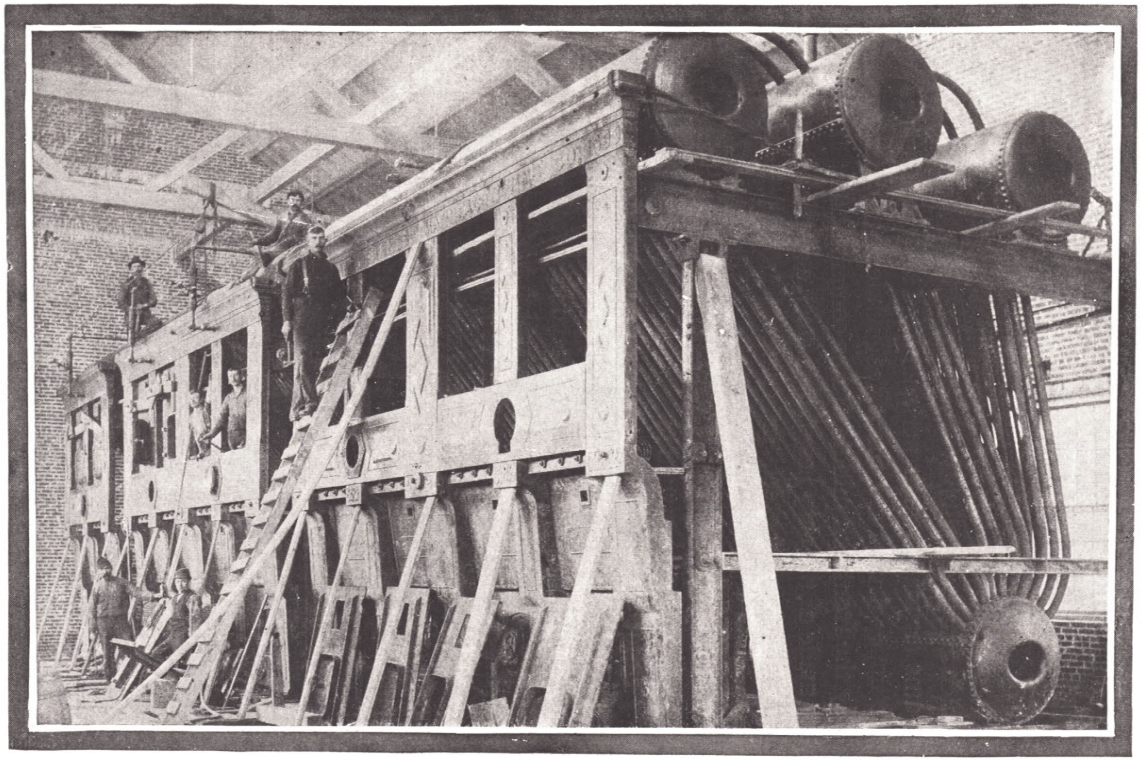
THE STIRLING BOILER.

THE Stirling Boiler consists of three upper or steam drums and one lower or mud drum connected by tubes, which are bent slightly so as to allow them to enter the drums normal to their periphery. The steam spaces of all the upper drums are connected, while the water spaces of only the front and middle drums communicate. The drums are made of the very best flange steel, and the tubes of either lap-welded mild steel, or charcoal iron, tested at 1,500 pounds pressure per square inch. The drums and tubes form the boiler, hence the very acme of simplicity has been attained in its construction.

Safety.—The boiler is, by its very design, a safety boiler. All parts are of wrought metal, and either spherical or cylindrical in form; thus all tendency to distortion under pressure is avoided. Cast iron, which has been such a fruitful source of trouble in other types, has been eliminated, and the absence of flat surfaces renders stay bolts and braces unnecessary. Ample provision has been made for unequal expansion and contraction, and all resulting strains therefrom are avoided.

Purchasers too often lose sight of the enormous power contained in steam and water at a high temperature under pressure; they forget that the energy stored in boilers is sufficient to throw them straight upward a height of from one to four miles, as Prof. Thurston has pointed out in his work on Steam Boiler Explosions, and they too frequently allow small differences in first cost to lead to the selection of boilers inherently weak and dangerous.

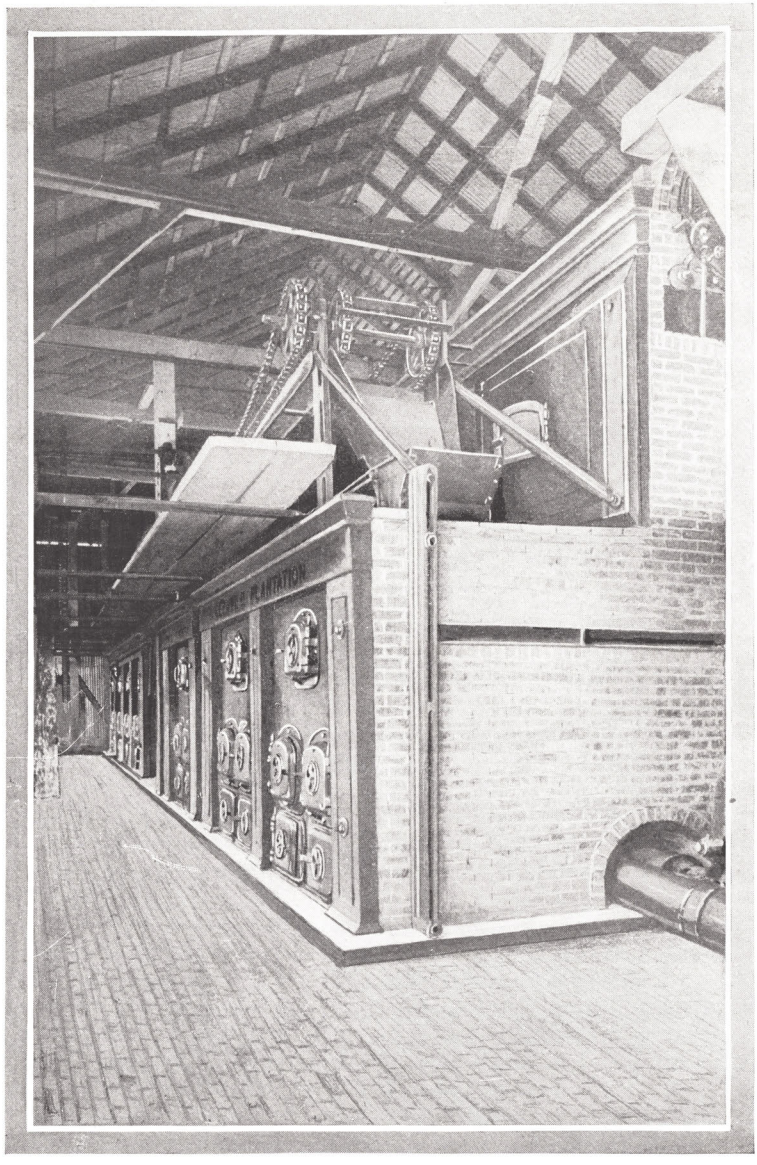
All serious explosions result from the sudden liberation of the energy contained in large masses of steam and water. If a rupture occurs in the shell of a tubular, flue, or cylin-



600 H. P. STIRLING BOILERS IN COURSE OF ERECTION AT WHITMAN & BARNES MFG. CO., WEST PULLMAN, ILL

drical boiler, the energy of all the steam and water within is suddenly released, to the destruction of the boiler itself and frequently of its surroundings, with accompanying loss of life. The same disastrous consequences attend a rupture in a water tube boiler when the part giving way contains a large quantity of steam and water. Thus, the bursting of headers in the horizontal type of water tube boilers is frequently accompanied by the most destructive results, owing to the fact that, although they do not in themselves contain large volumes of water, they are connected with a number of tubes, which, in the aggregate, contain a very large quantity of water and steam; and when the cast iron gives away, the rupture is not confined to a single spot, but extends throughout the entire length of the header, thus instantly liberating the water and steam contained in all the tubes expanded into it. A rupture in cast iron must, of necessity, extend throughout its entire length or breadth; while a rupture in wrought iron, or soft steel, is local, and can only be enlarged by the continued application of force. None of the so-called "safety boilers" then, in which cast iron is used, are worthy of the name. The term can only be applied to boilers in which the only possible points of rupture are confined to portions such as the tubes, containing small masses of water, and which are constructed of a material in which such rupture will remain local. This condition is admirably fulfilled in the Stirling Boiler.

Course of Gases.—By reference to the sectional view of the boiler, it will be seen that a fire-brick arch is sprung over the grates and immediately in front of the first section of tubes. This arch absorbs heat from the fire on the grates, and becoming an incandescent radiating surface after the fashion of the roof of a reverberatory furnace, ignites by radiation the new fuel as it is fed upon the fire, and thus



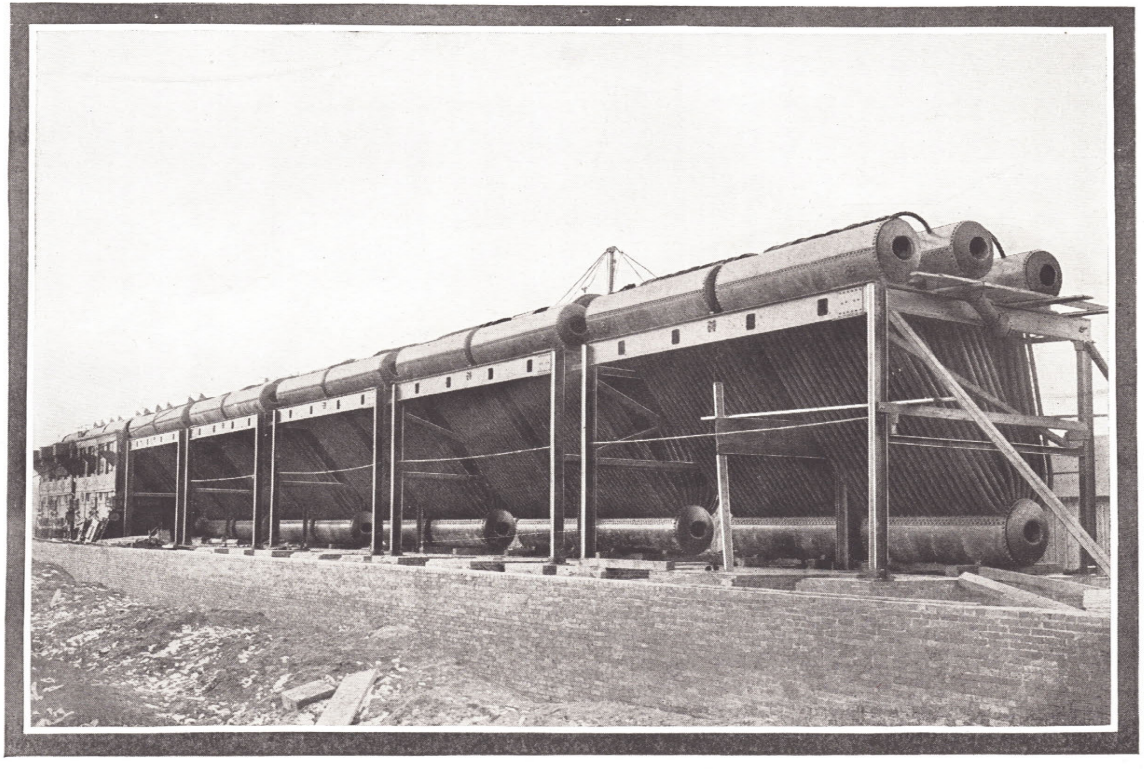
1,000 H. P. STIRLING BOILERS AT GLENWILD SUGAR REFINERY.
EQUIPPED WITH BAGASSE FURNACES.

promotes combustion; it insures an even distribution of the gases and prevents their concentration at any one point; and it heats to a high temperature the air which is admitted when the furnace doors are open for firing or cleaning, and prevents the boiler from being chilled by the inrush of cold air.

By suitably disposing fire-brick partitions or baffle walls, the gases from the furnace are led up among the first set or bank of tubes, depending from the front drum, thence down the middle bank, thence up the rear bank and on into the chimney at a greatly reduced temperature. In this long and circuitous passage every particle of the gases must come in contact with the tubes, which insures an exhaustive delivery of their heat to the water.

In no other boiler are the gases compelled to travel as far before reaching the stack, and as each 100° F. temperature at the chimney implies a difference of approximately six per cent in economy, it follows that the construction of the Stirling Boiler is such as to insure the highest attainable economy.

Handling Impure Feed Water.—The feed water enters the rear upper drum, the coolest part of the boiler, and as it descends to the mud drum is gradually heated by the gases on their final passage to the chimney to a sufficient extent to render insoluble much of the sedimentary matter that it contains, which is deposited in the mud drum in the form of mud or sludge, from which it may be blown off as frequently as may be found necessary. The mud drum is protected from the intense heat of the furnace by an ample bridge wall, and acts as an excellent settling chamber, the circulation in that portion of the boiler being comparatively sluggish. Should any of the precipitate collect in the rear bank of tubes the heat of the gases is so reduced by the



4,680 H. P. STIRLING BOILERS IN COURSE OF ERECTION AT PLANT OF COLUMBIA CHEMICAL CO., BARBERTON, OHIO.

time they reach that part of the boiler, that the deposit (unless it be allowed to remain neglected for a long time) is not baked hard, as it would be in tubes directly in contact with the furnace gases at their highest initial temperature, but may be readily washed out with a hose, or removed with any simple scraper. There is a sharp circulation up the front bank of tubes to the front drum, across from the front upper drum to the middle drum, thence down the middle bank of tubes, and so on in circuit; this water having been in a measure purified, the danger of scale formation in the parts of the boiler that are subjected to the most intense heat is greatly reduced; consequently the interior of these tubes remains clean and heat is transmitted more rapidly to the water, thus not only preventing the tubes from becoming over-heated and burning out, but at the same time maintaining the efficiency of the boiler. In boilers in which no such provision is made for the collection and deposit of scale-forming matter as in the Stirling, scale is deposited uniformly over the whole interior surfaces, with the result that the economy of the boiler decreases from the start, with the attendant danger of tubes burning out, etc.

In proof of the marked adaptability of the Stirling Boiler to situations where impure feed water must be used, we refer to an investigation made some time since of a boiler plant consisting of Stirling and water tube boilers of the horizontal type. We quote from the expert's report as follows:—

"The boilers were installed side by side; both were fed from the same water supply, and operating under the same conditions. The Stirling contained no visible scale and little deposit of any kind after one year's work and one cleaning; whilst the other boiler contained scale varying in thickness from 1/8 to 3/8 inches after two months' use since last clean-

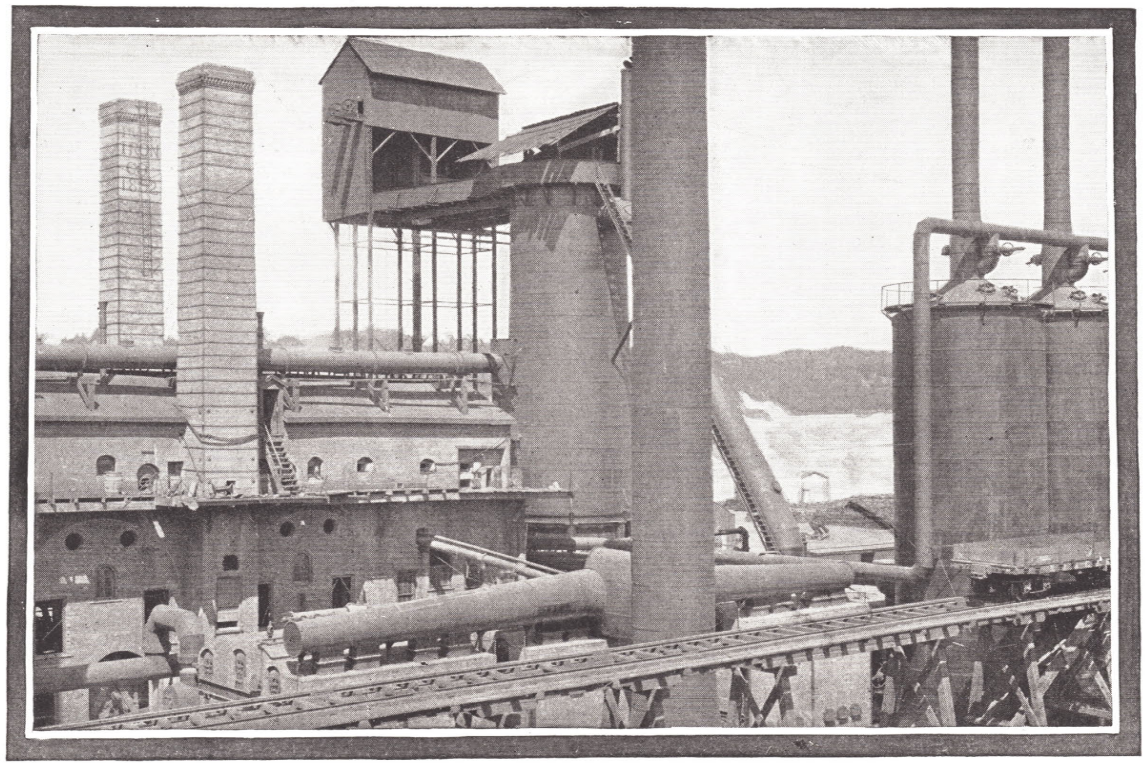
8,000 H. P. STIRLING BOILERS AT THE WESTERN AVE. PLANT OF THE CHICAGO UNION TRACTION CO.

ing. The labor of cleaning the Stirling Boiler during the year required only six minutes' time for each horse-power, while the cleaning of the horizontal water tube boiler required one hour and thirty minutes for each horse-power per year. *No less, then, than fifteen times as much labor was required upon the horizontal water tube boiler as was required upon the Stirling.* The water contains carbonate of lime in considerable quantity and traces of sulphate of lime."

CLEANING THE INTERIOR.—The removal of a man-hole plate from the end of each drum renders accessible for cleaning or examination every part of the interior. The drums are from 36 to 42 inches in diameter, so that a man may work inside with ease and comfort. Accumulations of scale in the tubes may be removed by a simple jointed or chain scraper, and if the water be particularly "hard," and productive of heavy scale, a cleaner, consisting of a cutting tool driven by a water turbine attached to a water hose, will readily and efficiently remove the scale with no labor on the part of the attendant beyond that necessary to guide the hose and cleaner attached, and direct it from one tube to another.

So much progress has been made in the development of tube cleaners for water tube boilers that the removal of scale from tubes (no matter whether they be straight or crooked, or whether the scale be heavy or light) is merely a question of the selection of the tool or device best adapted to the work to be done.

CLEANING THE EXTERIOR.—Ample cleaning doors are provided both in the sides and rear of the setting, so that the exterior of the heating surfaces may be kept clean and all accumulations of soot, ashes, etc., blown off as rapidly as they form by using a steam jet, which is furnished with every boiler.



THE POUGHKEEPSIE IRON CO.'S FURNACES, POUGHKEEPSIE, N. Y., OPERATING 1,200 H. P. STIRLING BOILERS.

The tubes being only slightly inclined from the vertical, there is no opportunity for soot and dust to settle on one side or on top of the tubes as in boilers of the horizontal type.*

Furthermore, the tubes are in parallel rows (not staggered as in some other types) and so arranged that it is possible to pass the hand, and indeed, the whole arm between two rows of tubes, and reach those in the fourth or last tier. The exterior surfaces, then, may be thoroughly cleaned of soot and kindred deposits with ease.

EXPANSION AND CONTRACTION.—The three upper or steam drums are supported by wrought iron beams resting on wrought iron columns, so that the brickwork may be removed or replaced without disturbing the boiler or its connections. The mud drum is suspended by the tubes expanding into it, and not being embedded in the brickwork is left free to allow for expansion and contraction.†

The bent tube in the Stirling Boiler performs the same function as the expansion loop or bend in a steam line, in that each individual tube may expand or contract (independently of the others) without straining the boiler as a whole. The circulation of the water is such as to maintain a uniform temperature in all parts; hence, not only are strains and leaks due to unequal expansion and contraction avoided, but a longer life, greater durability, and lower repair account are insured.

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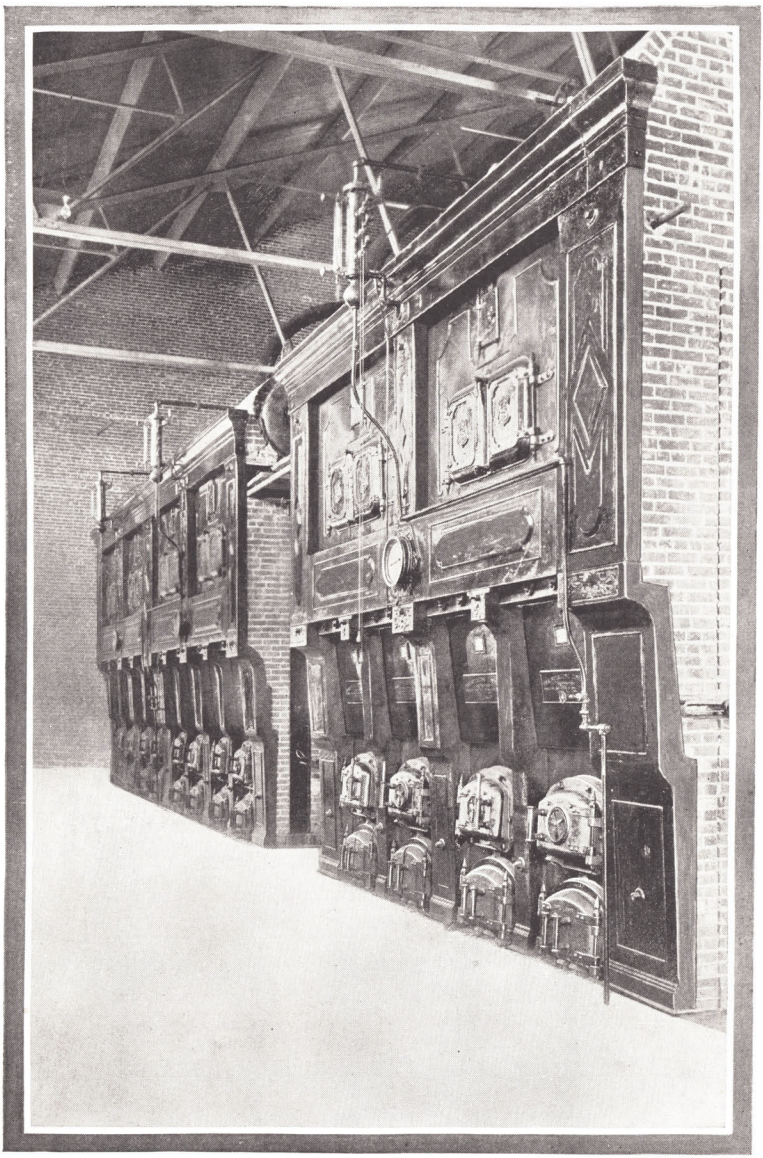
*NOTE—The importance of being able to clean a boiler thoroughly, outside as well as inside, and of keeping it clean, was well demonstrated by a comparative test made by one of our engineers some time ago, on a boiler which had been allowed to run some months without cleaning. Before cleaning the evaporation was found to be 8.04 pounds of water per pound of coal; and after cleaning the evaporation per pound of coal was 10.30, a gain of about 28 per cent.

†NOTE—As an evidence of the direct advantages resulting from this manner of supporting the Stirling Boiler, we refer to an explosion of natural gas in the furnace of a Stirling Boiler at the American Tin Plate Company's plant at Elwood, Ind. Although the force of the explosion was sufficient to entirely demolish the brickwork, the boiler was uninjured in any way whatever. The brick was replaced and the boiler placed in commission, without its having been necessary to make any repairs whatsoever to the boiler proper.



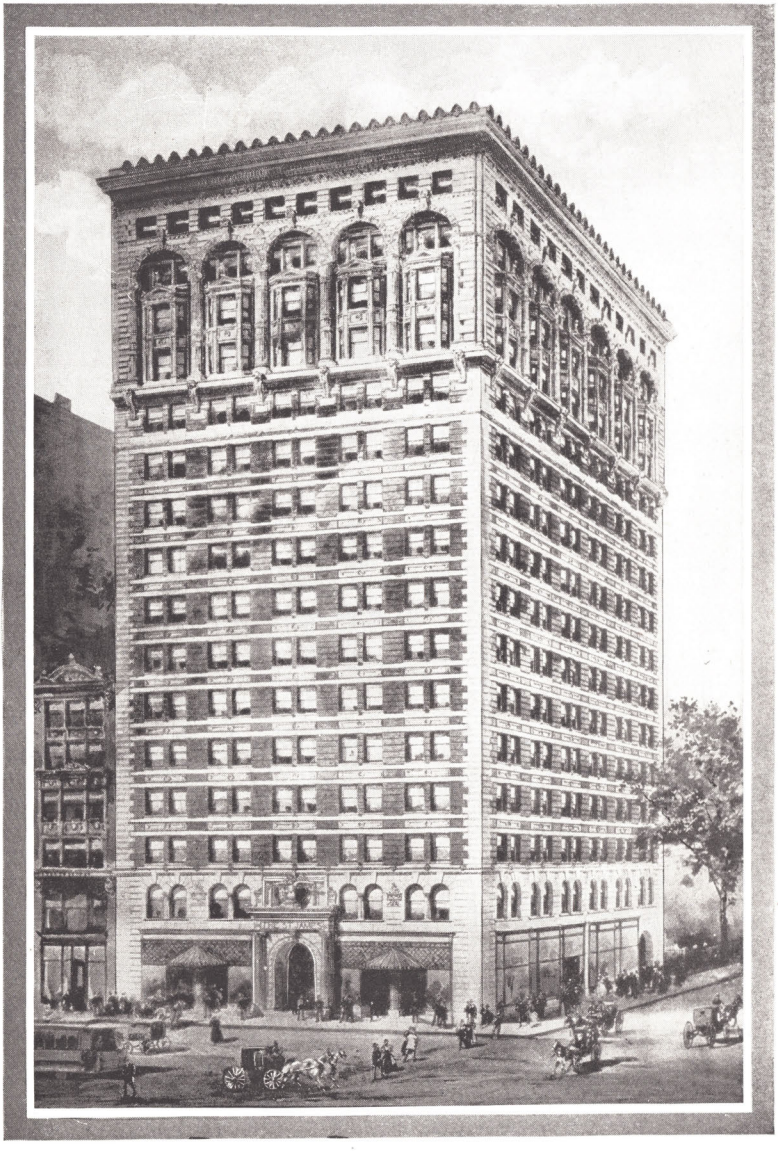
1,200 H. P. STIRLING BOILERS IN PLANT OF CLEVELAND & EASTERN RY., GATES MILLS, OHIO.

REPAIRS.—Should it become necessary to remove a tube in the Stirling Boiler it is merely necessary to cut the tube from the tube sheet, remove it through the doors provided for that purpose, introduce a new tube in the same way, insert it in its proper tube holes, and expand it. If the defective tube be an inner one, then it is necessary to remove but one good tube to get at it, but in no event is it necessary to distort the tube hole in the tube sheet or header by drawing the tube through the tube hole; nor is it ever necessary to remove more than one good tube to get at a defective one.

DRY STEAM.—The circulation of the Stirling Boiler is rapid and thorough; each tube furnishes its own outlet of 100 per cent. It naturally follows that the steam liberated at the surface of the water in the drum is not mixed with entrained water, and is dry. Further than this, the tubes are inclined at such an angle as to admit of easy and rapid liberation and ascent of the steam that forms in the tubes. The circulation of water in the middle bank of tubes is downward, and as the middle drum from which steam is taken is slightly higher than the rear and front drums, there is not only ample steam space, but there is absolutely no squirting or geyser-like action of the water and steam in this drum.

DIMENSIONS.—The Stirling Boiler is built to meet the varying requirements of height, width and depth, so that a 200 horse-power boiler can be built to occupy from 12 to 22 feet in height, 8 to 15 feet in width, and 14 to 17 feet in depth. It is therefore equally well adapted to boiler-rooms having low ceilings and ample width, as well as to those having little width and ample height. More horse-power of the Stirling type can be installed in a given number of cubic feet than of any other type on the market.

WORKMANSHIP.—The Stirling Company maintains its own shops, and its boilers are manufactured under the superintendence of its own engineers. All material is carefully tested, and every precaution that years of experience can suggest is taken to insure that the material, as well as the workmanship, of the boiler is of the highest grade obtainable.



ST. JAMES BUILDING, TWENTY-SIXTH AND BROADWAY, NEW YORK,
OPERATING 600 H. P. STIRLING BOILERS.

TESTIMONIALS.

We submit herewith a few of the many letters that have been written from time to time by users of Stirling Boilers in relation to their merits, superiority, etc. Many of these letters were written to an employe of one of our competitors, who addressed inquiries to our customers with a view of securing some damaging information that could be used against us in competition.

THE WALTHAM BLEACHERY AND DYE WORKS.

WALTHAM, MASS.

Dear Sir:—Your inquiry of the 31st ult., relating to the Stirling Water-Tube Boiler is at hand. We have installed in our plant four of the above-named boilers with a rated capacity of 375 horse-power each. These boilers were started January 1, 1896, and have been in constant use ever since. We are pleased to say that they have given entire satisfaction, and were we to install another plant, we would certainly adopt the Stirling Water-Tube Boiler.

Yours very truly,

G. E. JORDAN, Agent.

SAN FRANCISCO AND SAN MATEO ELECTRIC RAILWAY COMPANY.

SAN FRANCISCO, CAL.

THE STIRLING COMPANY,
12 Fremont St., City.

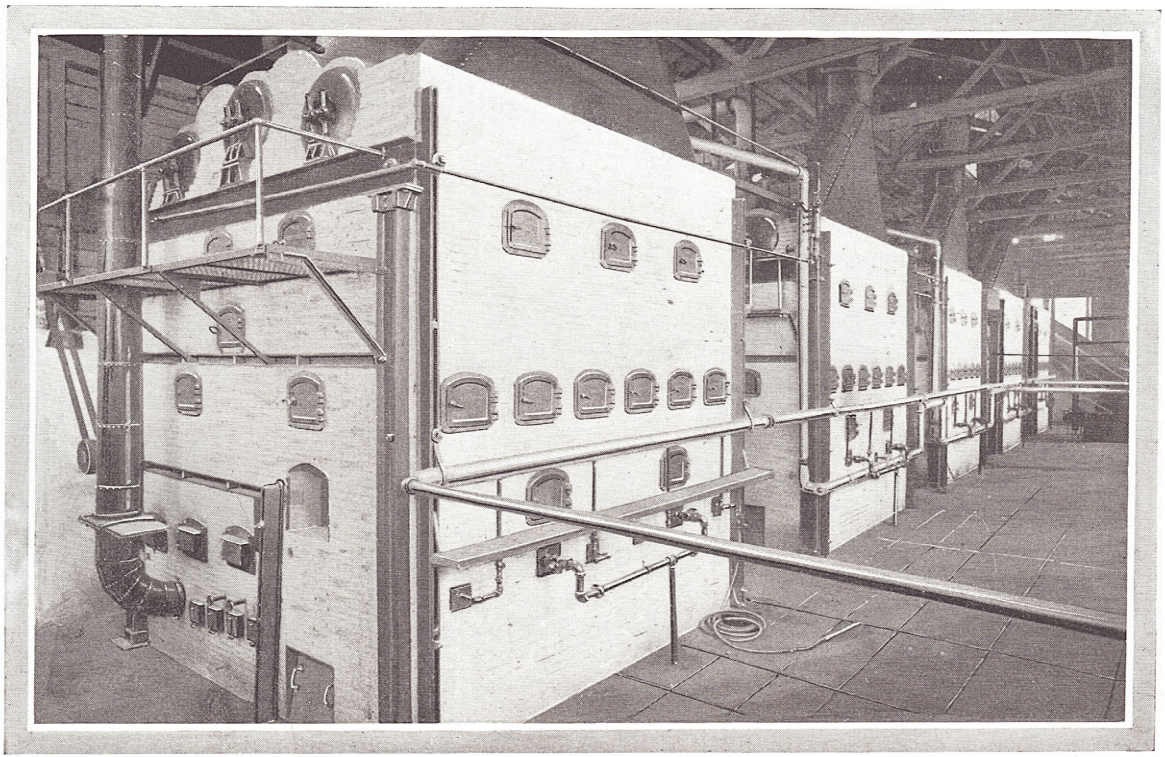
Gentlemen:—In response to your inquiry as regards the Stirling Boilers, installed at the power house of the San Francisco and San Mateo Electric Railway Company, we beg to state that the boilers have given perfect satisfaction, having been used 19½ hours a day continuously for the past eight years.

We find these boilers economical in the use of fuel, and also find that the repair bill has been almost nil in that time; and to all appearances the boilers are as good as when first installed.

We are pleased to give you this recommendation, in order to assure you that any statement made by your competitors to the contrary is untrue, and has not been authorized by us. Should we at any future time desire to increase our power plant, we should unquestionably, other things being equal, buy the Stirling Boilers.

Yours truly,

J. A. BUCK,
Vice-President and General Manager.



1,250 H. P. STIRLING BOILERS AT THE MAHANOY PLANE PLANT OF THE PHILADELPHIA & READING RAILROAD CO.

HEFFNER & COMPANY.

THE STIRLING COMPANY, CIRCLEVILLE, OHIO.
Cincinnati, O.

Gentlemen:—In 1891 we bought one of your 125 horse-power Water Tube Safety Boilers, which is in use to-day and in first-class condition. In 1897 we bought another 200 horse-power boiler of the same type, and both have given us perfect satisfaction. We find that these boilers are more easily kept clean than the tubular boilers we formerly used and are more economical and less expensive to operate. We consider them the safest boiler on the market to-day, which is a great satisfaction to owners of mills and factories in whose hands the lives of many employees are placed. Should we need more boilers we certainly would buy the "Stirling."

We remain, respectfully yours,
HEFFNER & CO.

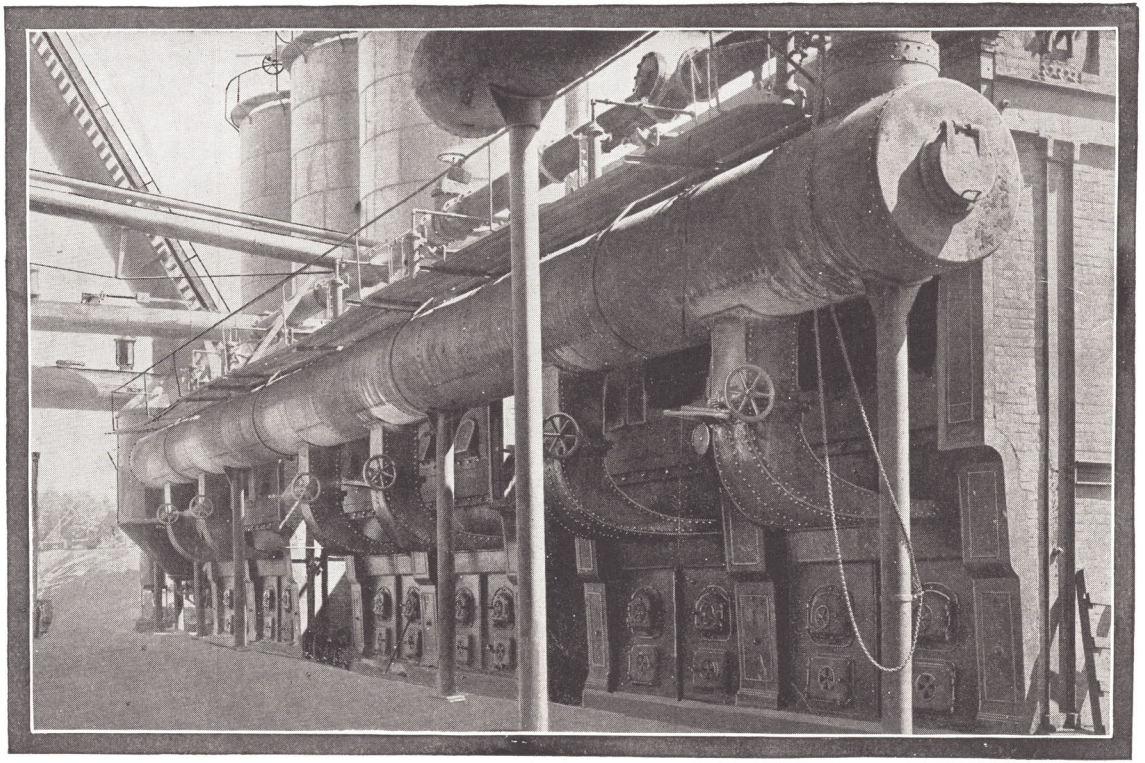
N. & G. TAYLOR COMPANY.

MANUFACTURERS OF AMERICAN TIN PLATE.

THE STIRLING COMPANY. PHILADELPHIA, PA.

Dear Sir:—Replying to your letter of the 22d and 29th inst., requesting some information as to our experience with the Stirling Boilers, would say that these boilers, a battery of two 75 horse-power each, have been in constant use since the fall of 1892. During that time they have been under a constant working pressure of from 90 to 110 pounds. Last fall one of the tubes opened in the seam, and we renewed that; also the one alongside of it, and two in the rear. This was not absolutely necessary, but as they were somewhat worn, we concluded it better to renew them. After these repairs we subjected the boilers to 162 pounds hydrostatic pressure and found them tight. We have had allowed us since 1892 by the Hartford Boiler Insurance Company 125 pounds pressure. After the above repairs had been made at my request, their chief inspector examined the boilers and allowed us a pressure of 150 pounds. This I asked for, as the future looked as if we would want an increased steam pressure. The boilers have cost very little for repairs up to the time above referred to. We have, in the time mentioned, renewed the grate-bars twice, and also put in new dead-plates and frame around the doors twice. The boilers are now, and always have been, free from scale. As far as my experience goes, the boilers have given perfect satisfaction. They make steam very rapidly.

Yours respectfully,
N. & G. TAYLOR TIN PLATE WORKS.
W. B. GODDARD,
Manager and Superintendent.



1,200 H. P. STIRLING BOILERS AT POUGHKEEPSIE IRON CO., POUGHKEEPSIE, N. Y., FOR BLAST FURNACE GASES.

THE LEHIGH COAL & NAVIGATION COMPANY.

LANDSFORD, PA.

THE STIRLING CO.,
Philadelphia, Pa.

Gentlemen:—With this I hand you orders for additional Stirling Boilers, 500 H. P., for No. 6 Colliery; 250 H. P., for No. 9 Colliery, and 1,000 H. P., for No. 12 Colliery. These bring our purchases from you up to about 6,500 H. P. during the past five years. In placing these orders, you were given the preference over your competitors because the Stirling type of boiler has proven so very satisfactory in our service that we have made it our standard. We have about 15,000 H. P. stationary boilers in use, including several kinds of the best known water-tube boilers, and I unhesitatingly pronounce the Stirling the best. It is a very rapid steamer, producing dry steam with small consumption of fuel. Its combustion chamber is a decided improvement over any other I know, and is an especially strong feature. Outside of renewing some brickwork in contact with fire, we have been at no expense for repairs to the Stirling boilers. When we first considered the question of placing a trial order with you, I feared the bent tubes might cause trouble, but such has not been the case. As the Stirling boilers permit the use of the cheapest grade of coal, in my opinion, they soon pay for themselves in the saving of fuel they effect.

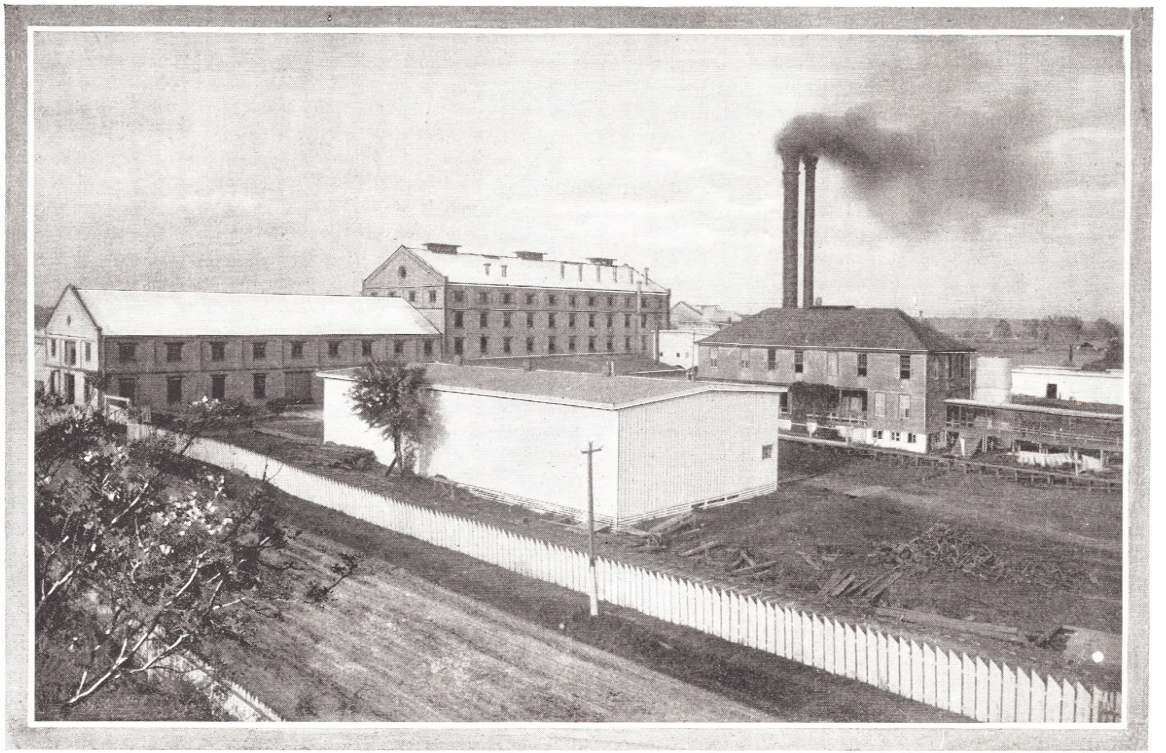
Respectfully yours,
W. D. ZEHNER, Superintendent.

ARMOUR PACKING COMPANY.

KANSAS CITY.

Dear Sir:—In answer to your letter of the 12th inst., regarding the Stirling Boilers, we have thirteen units aggregating 4,400 horse-power. The first installment of 1,000 horse-power has been in successful operation for more than seven years. The only serious difficulty we have encountered has been the accumulation of scale arising from use of bad water, which we have overcome very satisfactorily by the introduction of mechanical devices for cleaning the boiler tubes. We are not using purifiers, but have open heaters for heating our water. We feed direct to the rear drum, and depend entirely on the cleaner for removing scale. We can not give you an accurate record of the cost of repairs, but they are very light. The Stirling Boilers compare very favorably with the Babcock, or any other types of boilers in regard to generating steam. Yours very truly,

ARMOUR PACKING COMPANY,
G. W. TOURTELLOT, Supt.



THE CAFFREY CENTRAL SUGAR REFINERY, OPERATING 600 H. P. STIRLING BOILERS.

INDIANAPOLIS LIGHT AND POWER COMPANY.

MR. F. W. BOYER, INDIANAPOLIS, IND.
Wadsworth, O.

Dear Sir:—Your favor of the 10th inst. received. We have had 1,500 horse-power of Stirling Boilers in use since July, 1893, carrying 165 pounds boiler pressure. We have just closed a contract for 1,200 horse-power additional, to carry 200 boiler pressure. We had a great deal of difficulty in handling the Stirling Boilers when we first installed them, owing to the very bad water we have here. We use a Hoppes live steam purifier over each battery of boilers, which in a large measure does away with scale, but not altogether. They have perfected devices for cleaning these boilers so that they can be kept absolutely clean, if cleaned so often. I refer to the Union Boiler Tube Cleaner, made at Pittsburgh; the Chicago Boiler Cleaner Company's Impulse Cleaner, and other devices. We have had an experience during a number of years with all kinds of boilers, and it is our judgment that, if properly cared for, the Stirling Boiler is the best boiler on the market, and the least expensive to maintain. We had propositions for other boilers at a less figure, but preferred the Stirling Boiler for various reasons. During the season just passed we developed with compound condensing engines over 4,000 horse-power with 1,500 of these boilers. Very truly,

INDIANAPOLIS LIGHT AND POWER COMPANY,
C. C. PERRY,
Secretary and Treasurer.

THE LEHIGH PORTLAND CEMENT COMPANY.

THE STIRLING CO., ALLENTOWN, PA.
Philadelphia, Pa.

Dear Sirs:—Replying to your inquiry of the 22d inst., would say the five (5) 250 horse-power Stirling Boilers we have had in service at our Ormrod plant for nearly two years, have given us the best of satisfaction. They are economical and quick steamers. During the time these boilers have been in use it has not been necessary to change a tube. We were so well satisfied with them that we preferred and gave you our order last fall for six (6) additional 250 horse-power Stirling Boilers for our new plant at West Coplay. We now have a total boiler capacity of 2,750 horse-power, all of which are Stirling boilers.

LEHIGH PORTLAND CEMENT COMPANY.
CHAS. A. MATCHAM, Supt.

650 H. P. STIRLING BOILERS AT BLACKSTONE MANUFACTURING CO., BLACKSTONE, MASS.

THE CLEVELAND-CLIFFS IRON COMPANY.

THE STIRLING CO., GLADSTONE, MICH.
Betz Building, Philadelphia, Pa.

Dear Sirs:—Replying to your favor of April 22d, relative to our experience with the Stirling Boiler, beg to state that we have 500 horse-power Stirling Boilers at our blast furnace, which have been in constant service for fifteen months. During this time the cost of *maintenance has been practically nothing;* we have not lost a single tube, although you will notice, by analysis of water, that it is far from good, containing a large amount of solids to the gallon. While we have as yet made no test of these boilers, I feel absolutely safe in saying that they are developing considerably over 500 horse-power. We are very much pleased with them, and more especially so as the writer has used the Babcock & Wilcox and Heine water-tube boilers, and so far as I am concerned, *prefer the Stirling to either of the others.* After seeing the analysis of our water I feared we might have some trouble keeping the boilers clean; I am glad to be able to state this trouble has not been experienced. We have very little trouble with scale, finding most everything in the lower mud-drum, and only clean our boilers every four or five weeks, which we do in a very short time.

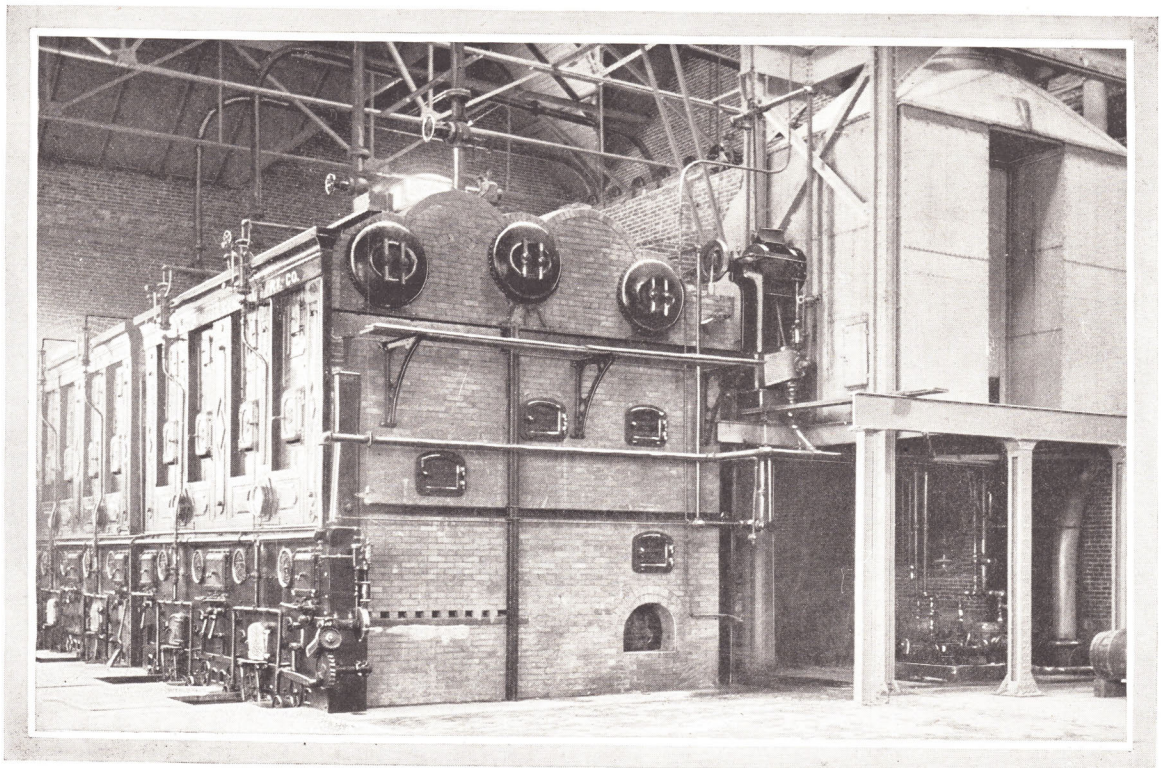
Yours truly,
AUSTIN FARRELL, Manager.

WEST MICHIGAN FURNITURE COMPANY.

THE STIRLING CO., HOLLAND, MICH.
Toledo, O.

Gentlemen:—Replying to your favor of the 21st, with reference to our 200 horse-power boiler which your people installed for us seven years ago, will say that this boiler has been in continuous use since that time and there never has been a dollar's worth placed upon it excepting the renewal of three or four tubes which were damaged when our factory burned in 1896. This boiler has seen exceptionally hard service ever since it was installed. It furnishes the steam to drive our engine which is performing from 300 to 350 horse-power work continuously. In addition, it drives the electric light engine of 35 horse-power, and furnishes the steam for the heating of our entire factory, 100,000 square feet of floor space, and a part of the time direct steam for the supplying of our kilns. We can say, without exaggeration, that this boiler has developed a daily capacity of 350 horse-power ever since it has been placed here. Under these circumstances you can say that we can recommend it unreservedly.

Yours truly,
WEST MICHIGAN FURNITURE COMPANY,
G. P. HUMMER, Secretary.



1,580 H. P. STIRLING BOILERS AND INDUCED DRAFT SYSTEM AT COLUMBUS CENTRAL RAILWAY CO., COLUMBUS, OHIO.

CENTRAL UNION DEPOT AND RAILWAY CO.

THE STIRLING COMPANY, CINCINNATI, O.

Cincinnati, O.

Gentlemen:—The battery of two 100 horse-power boilers installed by your company during the fall of 1897 were affording us such excellent satisfaction that we decided to adopt the Stirling Boiler for our Electric Light Station and, as you know, have just completed the installation of three 200 H. P. Stirlings in that department. Our personal and practical experience with your type of boiler has impressed us with its simplicity, while our previous objection to the crooked tube has been found to be wholly theoretical. We are pleased to take this opportunity of commending your boiler to the public in general and particularly to those who are looking for a first-class modern boiler.

Yours truly,

H. S. JOHNSON, Superintendent.

THE W. J. McCAHAN SUGAR REFINING COMPANY.

THE STIRLING CO., PHILADELPHIA, PA.

Philadelphia.

Dear Sir:—It gives us pleasure to state that we have at present 3,500 horse-power Stirling Boilers in use in our refinery and sugar house, 1,500 horse-power having been installed in 1892, 500 horse-power in 1894, 900 horse-power in 1895, and 600 horse-power in 1899.

Since their installation they have given perfect satisfaction in every respect, and we know of no other boiler that we would select in preference to the Stirling Boiler.

Yours very truly,

THE W. J. McCAHAN SUGAR REFINING COMPANY.

JAMES M. McCAHAN, Manager.

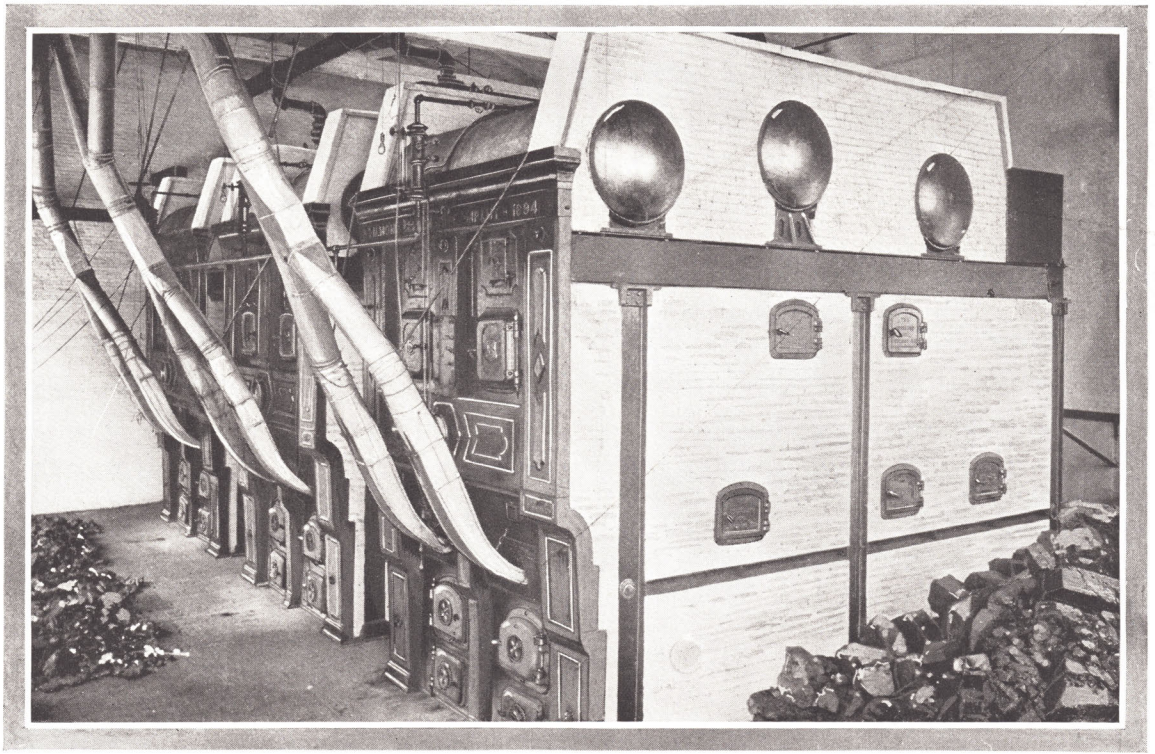
THE F. GRAY COMPANY.

THE STIRLING COMPANY, PIQUA, O.

Cincinnati, O.

Gentlemen:—Replying to yours of the 22d inst., in regard to the 200 horse-power boiler purchased of you in 1892, we are pleased to say that it has given us excellent satisfaction; have not lost one hour's time on account of it. We consider it the most economical steamer we have ever used or know of. Yours very truly,

THE F. GRAY COMPANY.



462 H. P. STIRLING BOILERS ARRANGED FOR BURNING SAWDUST, ETC., AT DIAMOND MATCH CO., BARBERTON, OHIO.

THE CINCINNATI & HAMILTON ELECTRIC STREET RY. CO.

THE STIRLING COMPANY, HAMILTON, O.

Cincinnati, O.

Dear Sirs:—In answer to your inquiry as to our experience with Stirling Boilers, am pleased to say that we have had the best of results with them. We have 1,000 horse-power, consisting of four 250 horse-power each, in two batteries of two each. These boilers are especially adapted for railway work; are ready steamers, and respond quickly when fired up to take care of a heavy load, especially on an interurban road, with grades, etc. I shall be pleased to give any further information. I remain, Very respectfully,

F. J. J. SLOAT.

THE JONES BROS. ELECTRIC COMPANY.

THE STIRLING COMPANY, CINCINNATI, O.

Cincinnati, O.

Gentlemen:—In answer to your inquiry as to how we like the Stirling Boiler, would say that we think that the duplicate orders we have given you after seven (7) years' experience with them speaks in higher praise than we can possibly do with the pen. We are satisfied the boilers are the best in the market.

Very truly,

THE JONES BROS. ELECTRIC COMPANY.

OFFICE BLACKSTONE MFG. COMPANY.

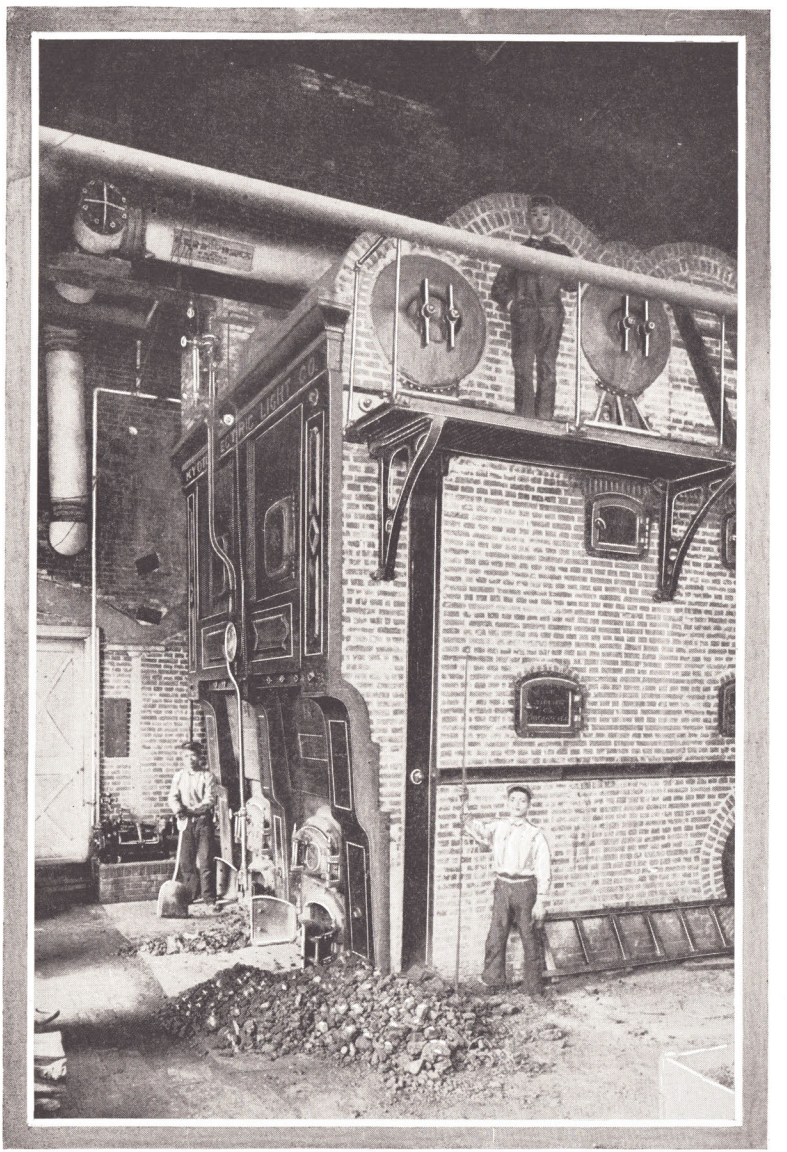
MR. E. T. STEVENSON, BLACKSTONE, MASS.

Pittsburgh, Pa.

Dear Sir:—Replying to your favor of recent date advising me that you were investigating water-tube boilers, and that you wished to know what type we are now using. Some years ago the Stirling people placed a 250 horse-power water-tube boiler in our boiler-house, and this boiler has been in constant use all this time, and I am pleased to be able to state that we have not in that time had to replace a tube, nor have we had one leak in this whole time. It has given us entire satisfaction, both as to steaming qualities and economy, and the cost of repairs so far has been nothing. Were we to replace any of our other boilers I would not hesitate a moment in placing the order with the Stirling Water-Tube Boiler Company.

I am, yours truly,

E. A. MONGEON, Supt.



500 H. P. STIRLING BOILER AT THE KIOTO ELECTRIC LIGHT CO.'S PLANT, KIOTO, JAPAN.

GALION LUMBER COMPANY.

THE STIRLING COMPANY, GALION, O.
Cincinnati, O.

Gentlemen:—For seven years we have used a Stirling Boiler and we are pleased to say that when we look back upon our experience with tubular boilers our Stirling has been to us seven years of pleasure and satisfaction. The water in this neighborhood is very bad, but three hours every 30 days is sufficient to keep our boiler in first-class condition, and is a record that no other boiler in this town can equal. We fire a mixture of shavings and slack, and run all of our machinery, heat the upstairs to the mill, the dry kiln, four rooms to our office, and furnish steam to a steam laundry next door. This is an immense amount of work for a 100 horse-power boiler, especially on such fuel, but we do it without difficulty. We can say nothing too good in the boiler's favor.

Yours very truly,
GALION LUMBER COMPANY.

NEW ORLEANS ACID AND FERTILIZER COMPANY.

THE STIRLING CO., NEW ORLEANS, LA.
City.

Gentlemen:—Your favor of 27th inst. is received. We have been using a battery of two Stirling Boilers, 200 horse-power each, for the past two years, and they have given us satisfaction.

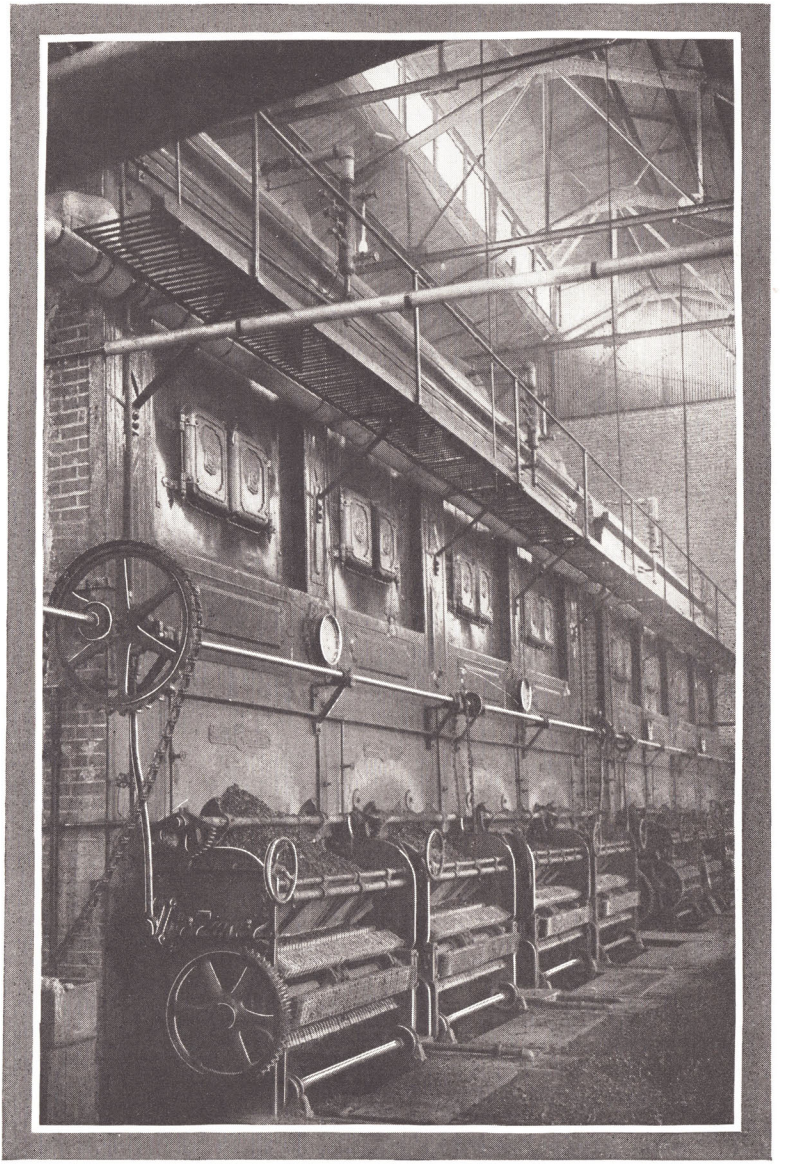
Yours truly,
W. L. GOLDSMITH, Manager.

PADUCAH RAILWAY AND LIGHT COMPANY.

THE STIRLING COMPANY, PADUCAH, KY.
Cincinnati, Ohio.

Dear Sir:—We have yours of the 22d inst., and in response to same will say that our experience with the Stirling Boilers we have in use here is highly satisfactory. We have one boiler that has been in use about four years, and another one a little over two years, and with the exception of relining furnace they have not cost a cent for repairs, They are good free steamers, and very economical on fuel.

Yours truly,
PADUCAH RAILWAY AND LIGHT COMPANY.



FORD PLATE GLASS CO., TOLEDO, OHIO, OPERATING 4,000 H. P.
STIRLING BOILERS.

THE WALSH-DeROO MILLING COMPANY.

THE STIRLING COMPANY, HOLLAND, MICH.
Toledo, O.

Gentlemen:—Our 175 horse-power Stirling Boiler was installed in 1892, and the repairs on it have been very light, consisting so far as we can recollect only of replacing a few tubes in the front row at two different times. We consider our boiler an excellent steaming device, and with the turbine tube cleaner, which we now use, the tubes are very easily made absolutely clean and at a moderate expense in the way of labor.

Yours truly,
WALSH-DeROO MILLING COMPANY,
C. J. DeROO, Mgr.

THE SHAW ELECTRIC CRANE COMPANY.

THE STIRLING COMPANY, MUSKEGON, MICH.
Toledo, O.

Gentlemen:—Replying to your inquiry of the 21st, we are able to say that we have had in constant use, for about 8½ years, one of your 100 horse-power boilers, and have had in use, for 6 months, a 150 horse-power boiler. We are well satisfied with them. They have always answered all the demands which we have made upon them, and these have sometimes been very heavy. Expense for repairs is light. We have never made an evaporation test, but we have good reason to believe that the boilers are very economical.

Yours very truly,
THE SHAW ELECTRIC CRANE COMPANY.
J. G. EMERY, JR., Mgr.

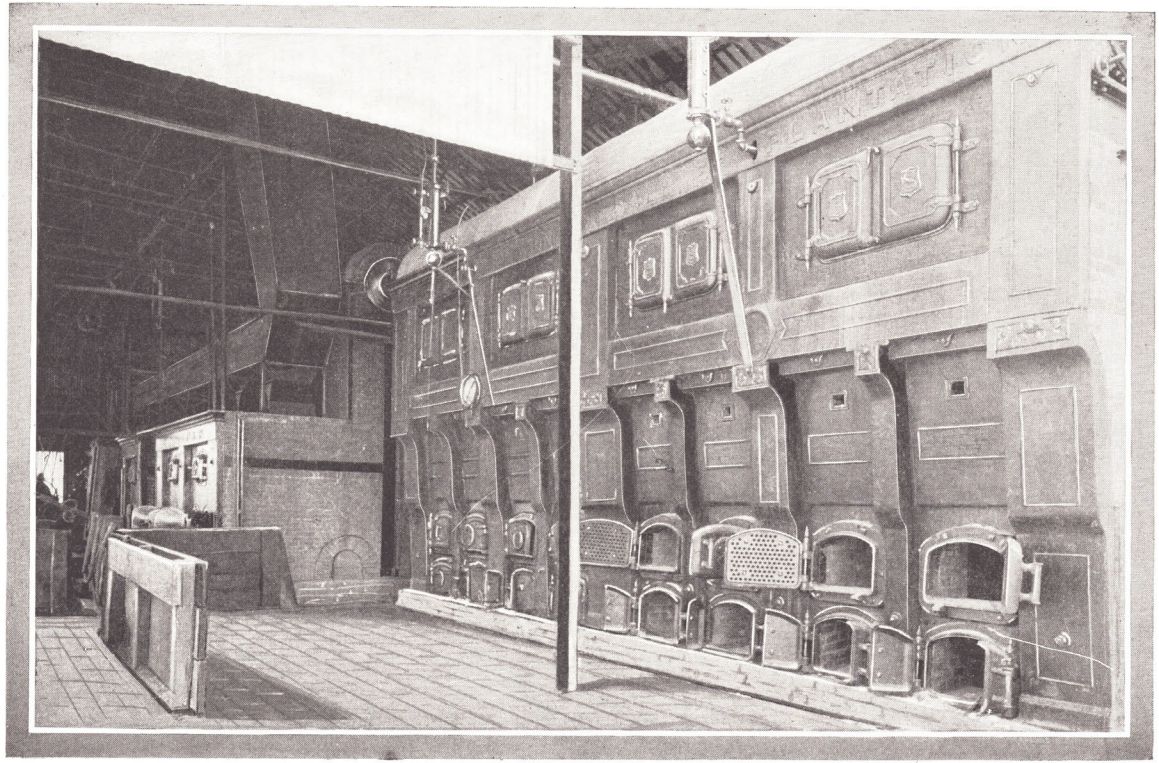
EDISON LIGHT COMPANY OF GRAND RAPIDS.

GRAND RAPIDS, MICH.

TO WHOM IT MAY CONCERN:

During the past eight years we have replaced our entire boiler plant, from time to time, with Stirling Boilers, and our outfit now comprises, of this type, two of 500 horse-power each, and three of 200 horse-power each. They are in splendid condition, cost very little for maintenance, and are of the highest efficiency. We believe them to be the very best procurable.

EDISON LIGHT COMPANY.
DANIEL McCOY, Pres.



1,000 H. P. STIRLING BOILERS AT CALUMET PLANTATION, PATTERSON, LA.

THE VIRGINIA HOT SPRINGS COMPANY.

THE STIRLING COMPANY, HOT SPRINGS, VA.
Cincinnati, O.

Dear Sir:—Replying to your favor of the 7th, would say that the "Stirling" comes up to our full expectations, and is giving entire satisfaction.

Yours very truly,
J. B. STEWART,
Superintendent Steam Electric Plant.

ED. H. CUNNINGHAM & CO.

THE STIRLING COMPANY, SUGAR ISLAND, TEX.
Chicago, Ill.

Gentlemen:—In 1896 we placed with you an order for 1,400 horse-power boiler—1,000 horse-power to be used with bagasse burners, and 400 horse-power to be used in our paper mill with coal. We have found these boilers very satisfactory, and consider them most efficient and economical. We have just placed an order for 1,000 horse-power more with your agents, C. S. Burt & Co., a few days ago.

Yours very truly,
ED. H. CUNNINGHAM & CO.

RICHMOND LOCOMOTIVE AND MACHINE WORKS.

THE STIRLING CO., RICHMOND, VA.
Philadelphia, Pa.

Dear Sir:—Answering your inquiry of the 22d inst, as to our opinion of the Stirling Boilers, we think that our favorable view of them is sufficiently evidenced by the fact that after using a battery of them for twelve months we ordered a second battery from you without asking the bid of any other maker.

Very truly yours,
J. R. BRYAN, President.

LEHIGH AND WILKES-BARRE COAL COMPANY.

WILKES-BARRE, PA.

Gentlemen:—In reply to yours of the 11th inst., we beg to say that we had excellent satisfaction from the Stirling Boilers, and consider them A No. 1.

Yours truly,
W. J. RICHARDS,
General Superintendent.

SHERRY BUILDING, FIFTH AVENUE AND FORTY-FOURTH STREET, NEW YORK,
OPERATING STIRLING BOILERS.

NASHVILLE WOOLEN MILL COMPANY.

THE STIRLING COMPANY, NASHVILLE, TENN.
Cincinnati, Ohio.

Dear Sirs:—Answering yours of March 22d, beg to say that the two 150 horse-power Stirling Boilers placed in our works by you February, 1899, are giving entire satisfaction, and we are very much pleased with them. Yours very truly,

NASHVILLE WOOLEN MILL COMPANY.
L. PARKS, President.

GREAT SOUTHERN FIRE PROOF HOTEL.

STIRLING BOILER COMPANY, COLUMBUS, O.
Chicago, Ill.

Gentlemen:—We have had one of your 250 horse-power boilers in use at this hotel for the last year, and must say that it has proven satisfactory in every particular, and the representations made by your representative have proven true in every particular. Wishing you every success, I remain, Respectfully yours,

THOMAS E. KEEGAN, C. E.

THE WYOMING VALLEY ELECTRIC LIGHT, HEAT AND POWER COMPANY.

THE STIRLING CO., WILKES-BARRE, PA.

My Dear Sir:—We have five of your Stirling Boilers in use at our works here, and, as you know, have recently given you an order for the sixth. The five have been in constant use for nearly four years; there has been very little expense for repairs, and are great steam producers. I consider the Stirling Boiler as one of the best.

Yours truly,
JOHN FLANIGAN, Gen. Manager.

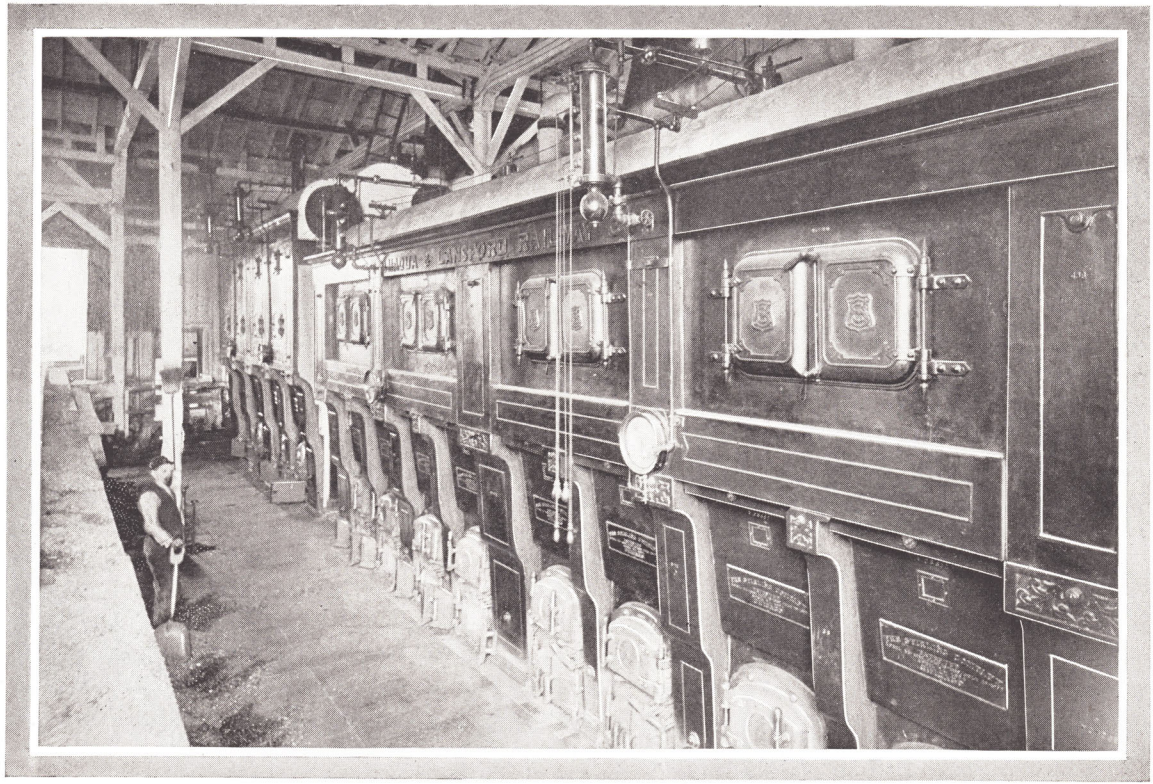
RICHARD HECKSCHER & SONS COMPANY.

SWEDE FURNACES.

THE STIRLING COMPANY, PHILADELPHIA, PA.
Philadelphia, Pa.

Gentlemen:—Your favor of the 22d inst. at hand. We have, of course, had your boilers in use a comparatively short time, viz., about nine months, but it gives pleasure to say that during this period they have given us entire satisfaction and we are well pleased with them. We have no objection to your making use of the above.

Yours very truly,
RICHARD HECKSCHER & SONS COMPANY.



STIRLING BOILERS IN TAMAQUA & LANSFORD RY. PLANT, LANSFORD, PA.

JOHN F. BETZ & SON, L'TD.

THE STIRLING CO., PHILADELPHIA, PA.
Betz Building, Philadelphia, Pa.

Dear Sir:—We have your letter of March 23, relative to our experience with the Stirling Boilers. We have had them in active service ever since 1894, and during no portion of the time could we speak other than as being highly pleased with their performance; they have afforded us perfect satisfaction. If the above can be made serviceable to you in the manner of extolling the boiler's merits, you are at perfect liberty to use our names in testimony of their good results.

Respectfully yours,
JOHN F. BETZ & SONS, L'TD.

GRAND RAPIDS BREWING CO.

THE STIRLING CO., GRAND RAPIDS, MICH.
Toledo, Ohio.

Gentlemen:—It is our pleasure to state that the Stirling Boiler which you installed in our plant some two years ago is giving the very best of satisfaction. We have as yet experienced no expense for repairs, and find it doing better work, with less fuel, than any boiler we have in use. Wishing you the best of success, we remain,

Respectfully,
GRAND RAPIDS BREWING CO.

COLUMBUS WOOLEN MFG. CO.

THE STIRLING CO., COLUMBUS, O.
Cincinnati, O.

Gentlemen:—The Stirling Boiler which you furnished us seven years ago has given perfect satisfaction in every respect. It is a money saver.

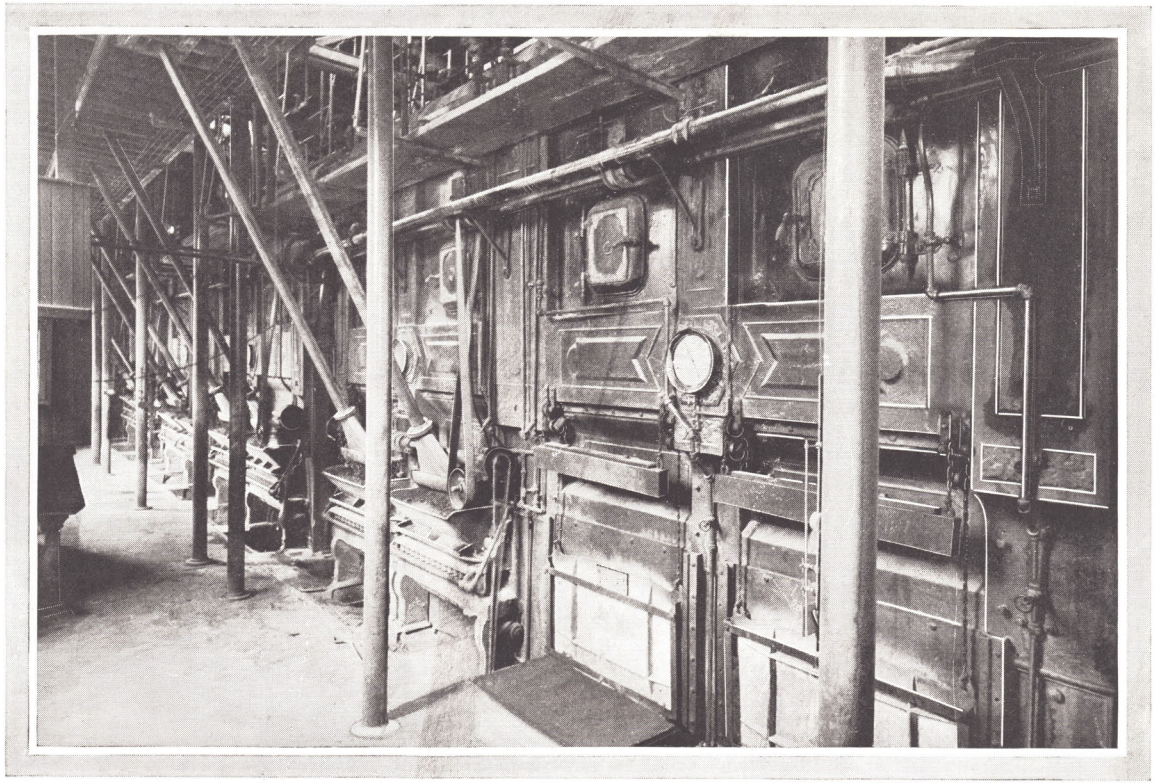
Yours truly,
THE COLUMBUS WOOLEN MILL CO.

CITY WATER WORKS.

THE STIRLING COMPANY, EVANSVILLE, IND.
Chicago, Ill.

Gentlemen:—In answer to your request of the 22d, will say that your boiler has been in constant use from 1895, and with very few repairs, and has given entire satisfaction. We have just installed three of the same type, 200 H. P. each, which is sufficient proof that the Stirling is a success.

Yours very truly,
GEO. F. MCELHINNY, Superintendent.



3,500 H. P. STIRLING BOILERS IN PLANT OF W. J. McCAHAN SUGAR REFINERY, PHILADELPHIA, PA

THE H. H. MEYER PACKING CO.

THE STIRLING CO., CINCINNATI, O.
Cincinnati, O.

Gentlemen:—We have used the Stirling Boiler nearly six years with good results and no repairs. We consider it a good boiler.

Respectfully,
THE H. H. MEYER PACKING CO.

WEIR FROG COMPANY.

THE STIRLING CO., CINCINNATI, O.

Dear Sirs:—We desire to say that the 500 H. P. Boilers installed by your Company at our Works are giving us satisfaction in every respect; we find them economical and efficient, and are very well pleased with them. Yours very truly,

CHAS. PARTINGTON, Superintendent.

WEST CHICAGO STREET RAILROAD CO.

THE STIRLING COMPANY, CHICAGO, ILL.
Chicago, Ill.

Gentlemen:—Answering your inquiry of even date herewith, I advise you that the same statements I made with regard to your boiler under date of November 15th, 1896, apply at the present time. The boilers are giving us no trouble whatever, have cost us nothing for repairs, and do their work satisfactorily at all times. I have no hesitation in again endorsing and recommending them strongly.

Yours truly,
GEO. A. YUILLE,
Ass't General Manager.

THE KRIPPENDORF, DITTMAN CO.

THE STIRLING COMPANY, CINCINNATI, O.
Water-Tube Safety Boilers.

Gentlemen:—In answering your letter regarding the Stirling Boilers, we are pleased to state that they have been in service since October, 1895. There has been no expense for repairs during this time and have on the whole given us perfect satisfaction.

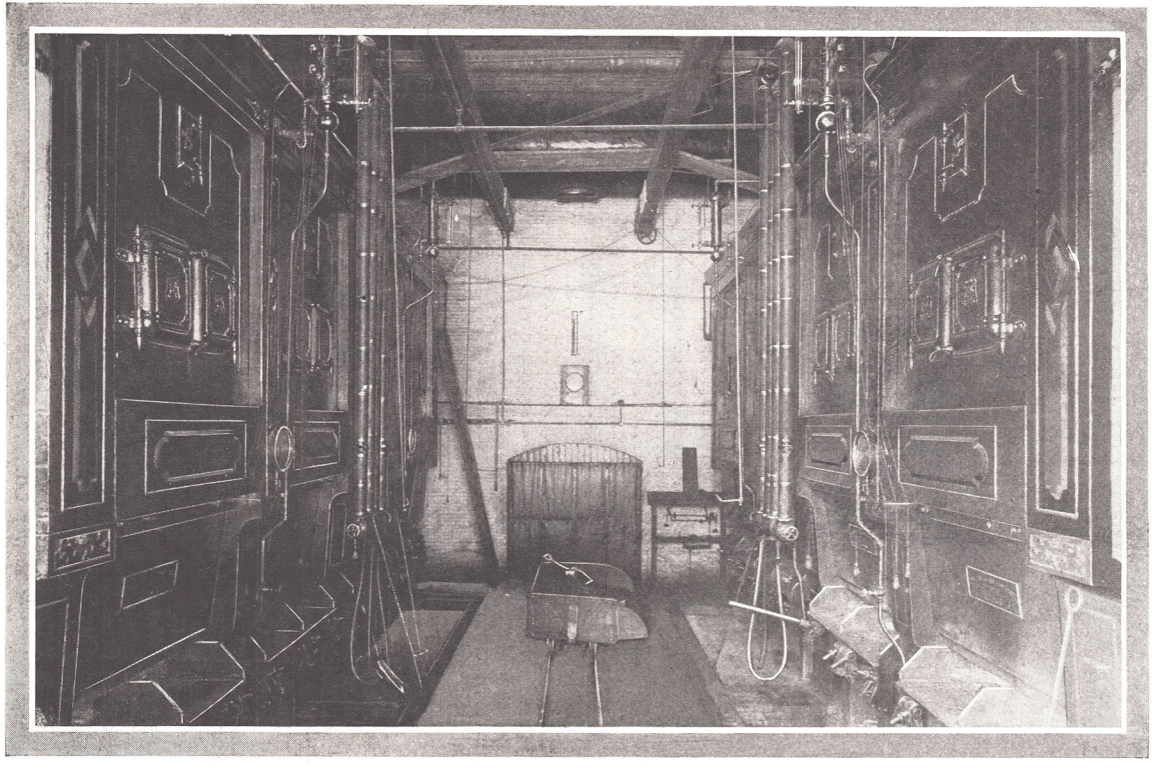
Respectfully yours,
THE KRIPPENDORF, DITTMAN CO.

NATIONAL STEEL CO.'S "AETNA STANDARD" WORKS, MINGO JUNCTION, OHIO, OPERATING 6,400 H. P. STIRLING BOILERS.

SOME USERS.

Among installations of Stirling Boilers aggregating about a million and one-half horse-power may be mentioned the following prominent plants. Attention is directed to the large number of repeat orders:

Name.	No. Orders.	Horse Power.
Colorado Fuel & Iron Co	6	29000
National Steel Co	10	26500
Republic Iron & Steel Co	24	20000
Armour & Co	21	18000
Union Steel Co	4	16000
American Steel & Wire Co	16	15000
Illinois Steel Co	10	15000
American Tin Plate Co	16	12000
Berwind-White Coal Mining Co	21	12000
Lehigh Coal & Navigation Co	16	10000
Chicago Union Traction Co	1	8000
Temple Iron Co	15	7500
Anaconda Copper Mining Co	5	7500
Cleveland Cliffs Iron Co	6	6000
Lehigh Portland Cement Co	5	5750
National Tube Co	4	5250
American Sheet Steel Co	10	5000
Cleveland Elec. Ry	3	5000
Diamond Match Co	12	5000
Northern Ohio Traction Co	7	5000
Lake Superior Power Co	6	5000
Diamond Rubber Co	9	5000
General Electric Co	2	4000
Guanica Centrale	2	3600
Los Angeles Pacific Ry. Co	5	3500
McCahan Sugar Refinery	4	3500
H. C. Frick Coke Co	4	3500
North American Chemical Co	4	3400
Boston & Montana Cons'd Copper & Silver Min'g Co.	2	3400
Minneapolis General Electric Co	3	3000
Los Angeles Traction Co	5	3000
Arcadian Copper Co	4	3000
Western Ohio Railway Co	2	3000
Minneapolis General Elec. Co	3	3000
Cincinnati Water Works	2	3000
American Smelting & Refining Co	10	3000
Wheeling Steel & Iron Co	5	2892
Cleveland City Railway	3	2700
B. F. Goodrich Co	6	2600
Lehigh & Wilkesbarre Coal Co	7	2550
Butte Lighting & Power Co	4	2528
E. H. Cunningham & Co	4	2500
Coplay Cement Co	4	2400
Brier Hill Iron & Coal Co	3	2250
Philadelphia & Reading Ry. Co	2	2250



1,500 H. P. STIRLING BOILERS AT WALTHAM BLEACHERY AND DYE WORKS, WALTHAM, MASS.

Name.	No. Orders.	Horse Power.
Lentz & Co.	6	2200
Cincinnati, Newport & Covington Ry. Co.	4	2000
Whitman & Barnes Mfg. Co.	4	2000
Youngstown Steel Co.	3	2000
San Gabriel Elec. Co.	3	1900
Northern Pacific Ry. Co.	3	1800
Cleveland, Elyria & Western Ry.	3	1800
Midvalley Coal Co.	8	1800
Virginia Portland Cement Co.	3	1610
National Military Home, Leavenworth, Kas.	3	1600
Richard Heckscher & Sons Co.	2	1600
Waltham Bleachery & Dye Works.	1	1500
Baltic Mining Co.	2	1500
Jones Bros. Elec. Co.	4	1500
Wheeling & Elm Grove Ry.	3	1500
Youngstown Iron & Steel Co.	2	1400
Ft. Wayne & Southwestern Traction Co.	2	1400
Mobile Lt. & Ry. Co.	4	1400
Wabash Paper Co.	3	1400
Algonquin Coal Co.	4	1400
Nova Scotia Steel and Coal Co.	2	1264
Mass. Consolidated Mining Co.	3	1250
Cramp & Sons Ship & Engine Bldg. Co.	4	1200
Morrell Packing Co.	3	1200
C., C., C. & St. L. Ry.	4	1100
Wheeling Traction Co.	2	1100
Oakes Mfg. Co.	3	1100
Emerson Mfg. Co.	3	1100
Selby Smelting & Lead Co.	2	1100
Acadia Coal Co.	5	1000
Cleveland, Painesville & Eastern Ry.	2	1000
Wolverine Mining Co.	2	900
Rush Run Coal & Coke Co.	2	900
Cleveland, Berea, Elyria & Oberlin Ry.	2	900
City of Evansville, Ind., Water Wks.	2	900
Redlands Electric Light & Power Co.	2	850
Eagle & Phœnix Mills.	4	800
Webster Coal & Coke Co.	3	750
LaFayette Street Railway Co.	3	750
University of Michigan.	2	700
Hecla Mining Co.	2	700
Blackstone Mfg. Co.	2	650
Edison Elec. Illum. Co.	3	650
Sherwin-Williams Co.	2	600
National Mining Co.	2	600
LaFayette Water Works.	2	500
Shaw Electric Crane Co.	2	200
Northern Electric Co.	2	200

For further information, estimates, drawings, etc., please address,

THE STIRLING COMPANY,
Pullman Building, Chicago.